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REPORT ON A MAMMAL SURVEY OF THE COSANGA RIVER DRAINAGE, ECUADOR

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ABSTRACT

A mammal survey was conducted of the Cosanga Valley, Napo Province, Ecuador. The Cosanga Valley is located on the eastern slope of the Andes. The ecosystem of the survey area is Evergreen Mountain Forest (Sierra 1999). Sherman traps, pitfall traps, and mist nets were used to collect the specimens. Twenty-two species of mammals were found from the survey area; of these, twenty were collected and two more were observed, representing an approximation of the small mammalian assemblage of this area. Among the specimens collected were seven species (*Cryptotis equatoris, Sturnira bogotensis, S. magna, Platyrrhinus nigellus, Eptesicus brasiliensis, Thomasomys erro,* and *Neusticomys monticolus*) that represent significant range records for their species. Moreover, three species (*Carollia perspicillata, T. erro,* and *N. monticolus*) represent new elevation records for their species in eastern Ecuador. Shannon-Weaver diversity analyses were performed for the overall mammalian diversity and bat diversity. Bat diversity was compared to other mountain forest locations.

Key words: Andes, Ecuador, Evergreen Mountain Forest, mammals, range records

RESUMEN

Se realizó un inventario de mamíferos en el Valle de Cosanga, Provincia de Napo, Ecuador. El Valle de Cosanga está localizado en la vertiente oriental de los Andes. El área muestreada forma parte del ecosistema de Bosque Montano Siempreverde. Se emplearon trampas Sherman y Pitfall, así como redes de neblina para la captura de los especímenes. En el área donde se realizó el inventario se encontraron veinte y dos especies de mamíferos, de las cuales veinte fueron colectadas y dos fueron observadas. Estas veinte y dos especies representan una aproximación del ensamblaje de pequeños mamíferos de esta zona. Entre las especies colectadas constan siete (*Cryptotis equatoris, Sturnira bogotensis, S. magna, Platyrrhinus nigellus, Eptesicus brasiliensis, Thomasomys erro,* y *Neusticomys monticolus*) que constituyen registros significativos de extensión de rango conocido previamente para sus especies. Adicionalmente, tres especies

(*Carollia perspicillata, T. erro,* y *N. monticolus*) constituyen nuevos registros altitudinales de estas especies en el Este del Ecuador. Se llevaron a cabo análisis de Shanon-Weaver para la diversidad total de mamíferos y para la diversidad de murciélagos. La diversidad de murciélagos fue comparada con la de otras localidades de bosque nublado.

Palabras claves: Andes, Bosque Montano Siempreverde, Ecuador, extensión de rango, mamíferos

INTRODUCTION

The Cosanga Valley is located on the eastern slope of the Andes, in Napo Province, about 65 km southeast of Quito, Pichincha Province Ecuador. This study was conducted from 22 July to 12 August 2005. Although the Cosanga Valley has been surveyed for birds (Ridgely and Greenfield 2001) and mammals (Muchala 2005) much of what is known about this region is from studies conducted at higher elevation (Albuja 1999; Jarrin-V 2003; Pozo and Trujillo 2004; Tirira 1999; Voss 1988, 2003). The justification of this study was best presented by Voss (2003) who stated "to date, no regional species lists or faunal descriptions of any kind have been published". The surveyed ecosystem is Evergreen Mountain Forest and Temperate Forest ecotone of the eastern Andes (Ridgely and Greenfield 2001; Sierra 1999). We report new range and elevation records in this study, which we suggest are due to the lack of sampling in this area.

We sampled in two locations (Fig. 1). The first is at Sierrazul, 10 km southwest of Baeza (0°33′00″S, 77°55′00″W) on the Río Aragón (tributary of the Cosanga), Napo Province. The area is primarily a flat alluvial plain (1900 m in elevation) surrounded by mountains. Most of the forest appeared to be secondary growth with some old growth at higher elevations. Almost all the large plants in the forest, including tree ferns (*Cyathea* sp.), cecropia, and many large hardwoods, have epiphytic vascular plants (mostly *Tillandsia* sp., Cyclanthaceae, and mosses) on them. The forest floor on the alluvial plain is an assemblage of fungi, ferns, lycopods, vines, horsetails (Equistaceae), bamboo, Haloragaceae, Araceae, and young hardwood trees. The mountain slopes have hardwood forests, interspersed with extensive patches of bamboo. Along one stream there are small fields of lichens with orchids.

The second location (Fig. 1) is at 12 km northwest of Cosanga (0°31′70″S, 77°52′99″W) in Napo Province Ecuador (1900-2100 m). Rio Cosanga runs the length of the Cosanga valley. Down slope from our study site at this location other streams merge from other valleys and the mountains. No caves were found near our site which may impact bat species diversity. This valley is steeply sloped right to the river's edge on both sides. The trees have many lichens (Basidioliquenes), epiphytic plants including mosses, *Tillandsia,* and ferns (of the family Polypodiaceae) on them. The stream banks are dominated in some places with species from the families Araceae, Arecaceae, Ceropiaceae, Chloranthaneae, Cyatheaceae, Cyclanthaceae, Flacourtiaceae, Lauraceae, Lobeliaceae, Melastomataceae, Meliaceae, Moraceae, Piperaceae, and Poaceae.

MATERIALS AND METHODS

Sherman traps were set along hiking trails on the forest floor, in trees, in streams, and on stream banks for 2940 trap nights. Bats were caught using mist nets over natural streams and over hiking trails. Pitfall traps were set in the forests, swamps, and along stream banks for 336 trap nights. There were four pitfall trap lines in each location with three to five buckets per line. Tomahawk traps were used for 126 trap nights. In comparing our trapping methods we found that all the rodents were caught in Sherman traps, all the shrews were caught in pitfalls, the opossum was caught in a tomahawk trap, and the bats were caught in

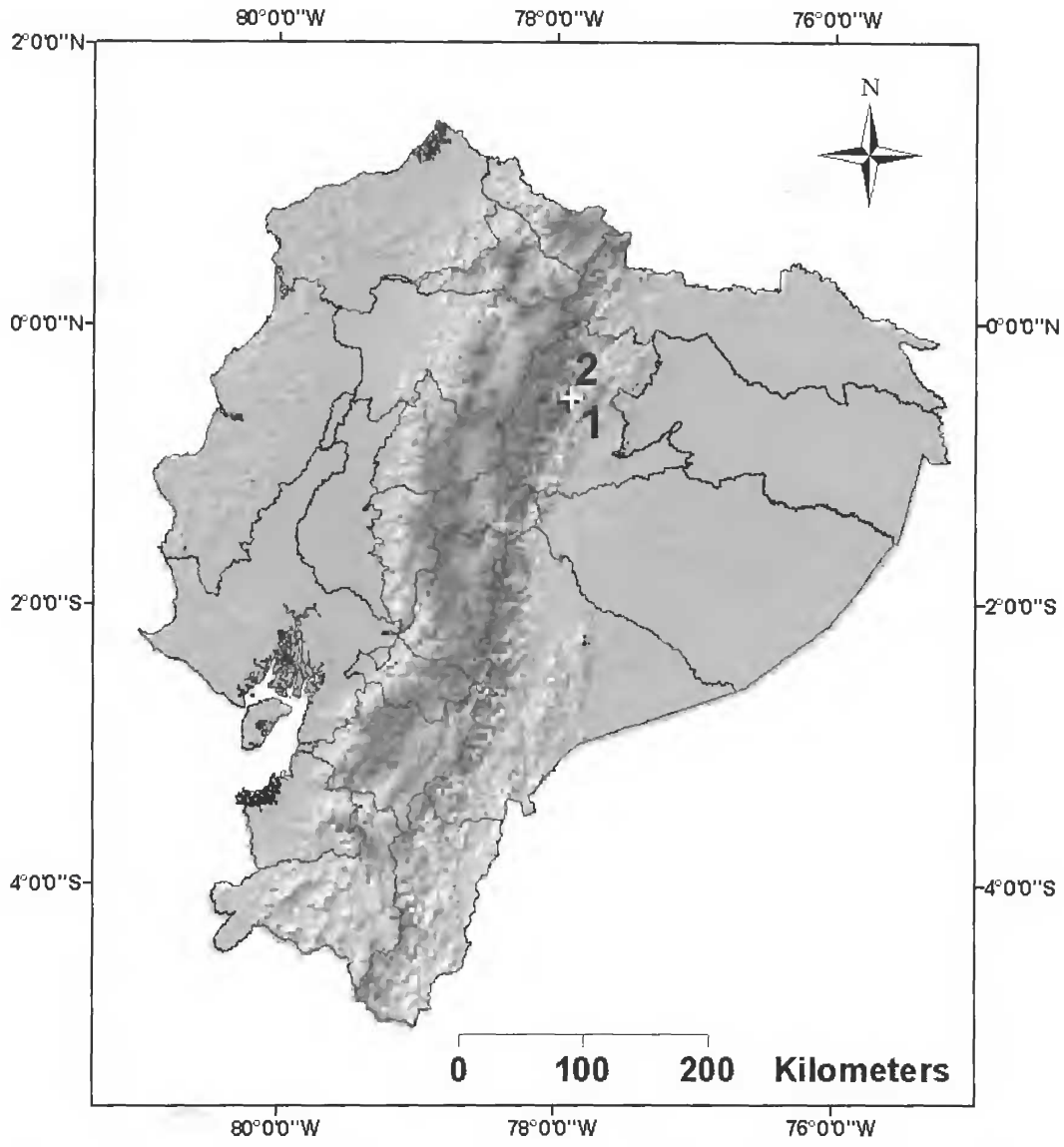

Figure 1. Sampled localities. 1 (black cross almost under the white cross) Sierrazul, 10 km southwest of Baeza (0°33′00″S, 77°55′00″W); 2 (white cross) 12 km northwest of Cosanga (0°31′70″S, 77°52′99″W).

mist nets or by hand in buildings. All voucher specimens (skins, skulls, and skeletons) were deposited in the Abilene Christian University Natural History Collection (ACUNHC) and Sección Mastozoología - Museo de Zoología Pontificia Universidad Católica del Ecuador (QCAZ). The ACUNHC is accredited by the American Society of Mammalogists and QCAZ is accredited by Ecuadorian law. All frozen tissues collected from the survey are deposited in the ACUNHC and QCAZ. A Shannon-Weaver Index was calculated using the formula $H' = n\log n - 3f_i \log f_i / n$ for the purpose of comparing the diversity of the locations surveyed in this study with other cloud forest sites (Shannon and Weaver 1949). The records and the identifications of the mammals presented in this paper were checked against specimens in the Sección

Mastozoología - Museo de Zoología, Pontifica Universidad Católica del Ecuador, British Museum of Natural History, and the United States National Museum. Some specimens that were of problematic identification were examined by other researchers working on Neotropical mammals.

RESULTS AND SPECIES ACCOUNTS

Presented in these results are a number of new records for the Cosanga River drainage. Many of our specimens represent records in either range or elevation that had not previously been reported. We suggest the new records reported here are examples of species that have been missed by previous sampling efforts. The survey is important because these results indicate there is still much to discover about mammalian biogeography of the Cosanga River drainage (Albuja 1999; Jarrin-V 2003; Pozo and Trujillo 2004; Tirira 1999; Voss 1988, 2003).

The Cosanga River drainage was found to have a comparable level of chiropteran diversity as other sites (Guajalito, Otonga, and Tandayapa) with a Shannon-Weaver diversity index value of $H^p = 0.82$. The overall mammalian diversity was $H^p = 0.90$ (Shannon and Weaver 1949). The species are arranged below in taxonomic order that follows Wilson and Reeder (2005).

ORDER DIDELPHIMORPHIA
Family Didelphidae
Didelphis pernigra Allen 1900
Andean White-eared Opossum

A single subadult male (ACUNHC 1105) was trapped from riparian habitat at the Sierrazul site. The vegetation on either side of the stream where the specimen was found was disturbed Evergreen Forest and fields of lichens with orchids. The animal was trapped next to a log that bridged the stream. Many small didelphid tracks were observed on the banks of the nearby Río Aragón. The range of *Didelphis pernigra* in Ecuador is well documented and this species has been taken near this locality before (Lemos and Cerqueira 2002; Tirira 1999). The all white ears are diagnostic for this species according to Alfred Gardner who checked the identification of this specimen from a photograph of the live animal.

ORDER SORICOMORPHA
Family Soricidae
Cryptotis equatoris (Thomas 1912)
Ecuadorian Least Shrew

Three specimens, one male, one female and one undetermined (ACUNHC 1106, QCAZ 7606, 7766), were collected in pitfall traps. Two specimens were caught in the same bucket on consecutive days. The location of this line was next to a slow moving, swampy stream in secondary forest at the Sierrazul site. The third specimen was caught by another researcher who was collecting insects at a nearby site (Yanayacu Biological Station, 3 km south of Sierrazul). All of these habitats have been disturbed by humans. These are the first records for *Cryptotis equatoris* south of the equator in the country (Eisenberg and Redford 1999; Tirira 1999).

ORDER CHIROPTERA
Family Phyllostomidae
Anoura fistulata Muchhala, Mena-V., and Albuja-V. 2005
Tube-lipped Long-tongued Bat

Two specimens (ACUNHC 1145 and QCAZ 7594), a male and a female, were collected in secondary forest from the Sierrazul site. This is 20 km north and 20 km south of two other locations where this species has been collected before (Muchhala et al. 2005).

Anoura geoffroyi Gray 1838
Common Hairy-legged Long-tongued Bat

Three male specimens (ACUNHC 1143 and QCAZ 7608, 7623) of *A. geoffroyi* were collected in a net that was placed one meter above a stream (measured from the base). These specimens were taken

over a dry temporary streambed from the Sierrazul site. This species has been previously collected about 10 km east of this location (Albuja 1999). This location is well within the elevation range for the species (Patterson et al. 1996).

Carollia brevicauda (Schinz 1821)
Medium Short-tailed Fruit Bat

Four specimens were collected, two females (ACUNHC 1139, 1140) from both sites and two males (ACUNHC 1141, QCAZ 7796) from the Cosanga site. Both were taken in disturbed habitat of secondary growth forests. This is 20 km north and 20 km south of two other locations where this species has been collected before (Albuja 1999). This location is well within the elevation range for the species (Patterson et al. 1996). The morphology of the lower jaw was used to distinguish the species of *Carollia* (Pine 1972).

Carollia perspicillata (Linnaeus 1758)
Common Short-tailed Fruit Bat

Three females (ACUNHC 1178, QCAZ 7713, 7718) were collected in a small field all from the Cosanga site. This species has been taken near this site before (Albuja 1999). This location is 200 m above the elevation record reported for the species (Patterson et al. 1996).

Sturnira bidens Thomas 1915
Andean Yellow-shouldered Fruit Bat

Ten specimens (ACUNHC 1117-1120, 1225, QCAZ 7600, 7610, 7629, 7744, 7759), six males and four females, representing both locations were caught. These specimens were caught at 1900 m, which is close to the lower limits of the elevation range for the species (Albuja 1999; Patterson et al. 1996). There are records within 20 km of both locations for this species (Albuja 1999).

Sturnira bogotensis Shamel 1927
Bogota's Yellow-shouldered Fruit Bat

Eight males and nine females (ACUNHC 1125, 1131, 1133, 1142, 1166, 1181, 1198, 1199, 1227-1229, QCAZ 7599, 7626, 7629, 7632, 7633, 7747) of *Sturnira bogotensis* were caught between both locations. All of these bats had a flat palate and forearm measurements between 43 and 45 mm. The charcoal pelage is much more uniform in color then that of *S. erythromos* which have lighter gray underfur. This bat is considered rare in Ecuador south of the equator and little is known about its geographic and elevational distribution (Albuja 1999; Tirira 1999).

Sturnira erythromos (Tschudi 1844)
Dark Yellow-shouldered Fruit Bat

Twenty-one individuals, eight males and thirteen females (ACUNHC 1126, 1132, 1138, 1148, 1179, 1187, 1189, QCAZ 7597, 7618, 7625, 7631, 7639, 7726, 7727, 7729, 7737, 7743, 7745, 7746, 7761, 7765) were caught in many habitats within the study site area. All of these specimens were dark brown to black in color with gray underfur. There are records of this species from near our collecting site, and it is within the recorded elevation range for the species (Albuja 1999; Patterson et al. 1996). These bats all had flat palates and forearms that measured between 40 and 42 (Giannini and Barquez 2003).

Sturnira magna de la Torre 1966
Great Yellow-shouldered Fruit Bat

One female (QCAZ 7725) was netted in a small field at the Cosanga site. This specimen represents the first specimen from 1900 m. This is first record for the Evergreen Mountain Forest of the east. The highest record before this specimen had been 1090 m. All other records are from the subtropical, humid, and tierra firme forests of the lowland east in Ecuador (Albuja 1999). However, Patterson et al. (1996) reports this species at 2330 m elsewhere. This specimen is also the first from Napo Province with the nearest record 70 km to the east.

Sturnira oporaphilum (Tschudi 1844)
Eastern Yellow-shouldered Fruit Bat

Eighty-six individuals (ACUNHC 1121-1124, 1127-1130, 1134-1136, 1144, 1147, 1149-1153, 1155, 1157-1159, 1161, 1162, 1167-1172, 1182-1186, 1190-1196, 1200, 1226, QCAZ 7596, 7598, 7607, 7611, 7612, 7619, 7620, 7624, 7627, 7628, 7630, 7635, 7636, 7638, 7640, 7653, 7690, 7691, 7695, 7703-7708, 7716, 7717, 7721, 7722, 7724, 7728, 7732, 7740,

7750, 7757, 7758, 7760, 7762-7764, 7767, 7774) were caught in all of the habitats examined in this study. There were 29 males and 57 females in the sample. Eight of the females were lactating and three had embryos. There are records near our sites for this species. These specimens were collected (1900 m) nearer to the upper limits (2750 m) of their elevation range (Patterson et al. 1996). Usually these specimens have a forearm greater than 45 mm. However, in some subadults the forearm was as short as 42 mm. When the forearm was less than 45 mm the curvature of the palate (or lack of) was use to identify the species (Giannini and Barquez 2003).

Dermanura glauca (Thomas 1893)
Common Fruit-eating Bat

Fourteen (ACUNHC 1156, 1163-1165, 1180, 1197, 1224, QCAZ 7622, 7645, 7648, 7702, 7709, 7720, 7791) *Dermanura glauca* were netted in two locations. Six individuals (two males and four females) were caught at Sierrazul. Eight (four males and four females) were taken from Cosanga. These specimens were collected in many habitats at both sites. Most of the individuals collected in this study had distinct facial stripes. All had the distinctive, minute, third, lower molar for this species. There are other records of this animal within 20 km of our sites, usually at lower elevation (Albuja 1999).

Platyrrhinus nigellus (Thomas 1900)
Thomas's White-lined Fruit Bat

Two specimens (ACUNHC 1805, QCAZ 7749), one male and one female, of *Platyrrhinus nigellus* were found on the Cosanga site. These specimens all had clearly visible buff-colored facial stripes and a bright dorsal stripe. This color pattern probably rules out that these specimens are *P. chocoensis* (Ferrell and Wilson 1991; Tirira 1999, 2001). The range of *P. nigellus* is not well documented in Ecuador (Albuja 1999; Velazco and Solari 2003). There are records from the southern Cosanga River Valley. However, our sample is one of only seven from the eastern Andean subtropical ecosystem of Ecuador (Velazco and Solari 2003). The closest record is near Tena, 50 km to the southeast of the Cosanga site (Albuja 1999; Velazco and Solari 2003). There is not enough information on the elevation range of this species to determine the significance of our specimens.

Family Molossidae
Tadarida brasiliensis (Geoffroy 1824)
Brazilian Free-tailed Bat

Twenty individuals, 12 females and 8 males (ACUNHC 1108-1116, 1188, QCAZ 7604, 7605, 7613, 7615, 7616, 7661-7665), were collected in a wood shed (without walls) at the Sierrazul site. The nearest record for this species is just north of Volcan Sumaco, which is 40 km east of the Sierrazul site (Albuja 1999). One of the individuals was a light tan color; the rest were the usual brownish gray. This location is well within the elevation range for the species (Patterson et al. 1996).

Family Vespertilionidae
Eptesicus brasiliensis (Desmarest 1819)
Brazilian Big Brown Bat

Only one female (QCAZ 7723) was netted over a small field at the edge of secondary forest. The nearest record is 65 km to the northwest of the Cosanga site (Albuja 1999). Moreover, this bat has rarely been found at 1900 m in the eastern Andes of Ecuador (Albuja 1999). This specimen is 108 mm in total length and is larger than a similar species *E. andinus* that is found in the lowlands (Simmons and Voss 1998).

Histiotus montanus (Philippi y Landbeck 1861)
Andean Big-eared Bat

One male specimen (QCAZ 7601) was found from Sierrazul. The bat was located in a wood shed at 1900 m which represents a low elevation record for this species in Ecuador (Albuja 1999). However, Patterson et al. (1996) reports that this species has been found as low as 700 m. This species has been reported on Volcán Antisana which is 20 km west of the Sierrazul site and at 4020 m in elevation (Albuja 1999). This specimen is larger than the congeneric *H. humboldti* and our specimen does not have the lachrymal ridge found in *H. humboldti* (Handley 1996).

Myotis keaysi Allen 1914
Hairy-legged Myotis

Five specimens (four males and one female, ACUNHC 1146, 1154, QCAZ 7603, 7614, 7617) were collected. Two of these specimens were caught at a pond adjacent to secondary growth forest. The others

were found in a barn. This species has previously been recorded within 20 km of this area (Albuja 1999). This location is well within the elevation range for the species (Patterson et al. 1996).

ORDER RODENTIA
Family Cricetidae
Oryzomys balneator Thomas 1900
Ecuadorian Oryzomys

Fifty-five individuals, 28 males and 27 females (ACUNHC 1160, 1173-1177, 1201-1223, QCAZ 7605, 7676, 7677, 7700, 7701, 7711, 7712, 7714, 7715, 7730, 7731, 7733, 7734, 7736, 7738, 7741, 7742, 7748, 7751-7753, 7756, 7768, 7770, 7772, 7778), of *Oryzomys balneator* were collected from both the Sierrazul location and the Cosanga site. There is not enough distribution information to determine the significance of these specimens. This species did seem to be uncommon at the Sierrazul site ($n = 6$). However, they were particularly common near streams at the Cosanga site ($n = 49$ at 1900 m). All of the specimens of *O. balneator* that we caught have a sphenofrontal foramen and the trough for the masticatory-buccinator nerve is perforated. *Oligoryzomys* lack the sphenofrontal foramen and the trough is not perforated (Carleton and Musser 1989). Carleton and Musser (1989) indicate that *O. balneator* is probably a *Microryzomys*, therefore our specimens are compared here with members of that genus. All the specimens have the incisor capsule pattern of *M. altissimus* and all have a maxillary toothrow greater than 3 mm, which is indicative of *M. altissimus* (Carleton and Musser 1989). However, the hind foot lengths for all 55 specimens are between 24 mm and 30 mm, which are larger than both species of *Microryzomys* (Carleton and Musser 1989). Finally, some of our specimens were sequenced for 800 bp of cytochrome-*b* and were found to be 7% DNA divergent from a known *O. balneator* and 15% DNA divergent from known samples of *M. minutus*.

Neusticomys monticolus Anthony 1921
Mountain Water Rat

One individual, a lactating female (QCAZ 7830), was caught with a Sherman trap that was placed in a forested mountain stream. As described by Tate (1931), our specimens were taken by a small waterfall and the traps were exposed to the spray of water from the fall. There are no records of this species outside of the Paramo from the eastern subtropical ecosystem of Ecuador (Eisenberg and Redford 1999; Tirira 1999; Voss 1988). This specimen represents a low elevation record in Ecuador at 1900 m for the eastern Andes. Lee et al. (2006) documented this species at 1850 m on the west side of the Andes and Voss (1988) documented *N. monticolus* in Ecuador between 2,245 and 2,290 m. Specimens collected by Voss (1988) from Ecuador were found in three locations: San Ignacio, Guarumal, and Papallacta. These locations are not only higher in elevation from our sites, but they are part of the very different Paramo ecosystem.

Thomasomys erro Anthony 1926
Anthony's Andean Mouse

Three specimens, two females and one male (ACUNHC 1137, QCAZ 7595, 7811), were collected from both the Sierrazul and Cosanga. These locations are 35 km west of the type location (Volcán Sumaco) and 30 km southeast of Papallacta where additional specimens of *Thomasomys erro* have been taken. Both the Sumaco and Papallacta sites are above 3500 m and are part of the Paramo ecosystem (Voss 2003). Therefore, these are the first records for this species from the Evergreen Mountain Forests at 1900 m. These specimens have a rostral tube and a hind foot of 30 to 32 mm, which together separate *T. erro* from all other *Thomasomys* in the Cordillera Oriental of Ecuador (Voss 2003).

The two species observed but not collected were *Sciurus granatensis* and *Sylvilagus brasiliensis*. Both were found on the same trail in riparian habitat of the Río Aragón at the Sierrazul site.

DISCUSSION

The chiropteran community of the two Cosanga sites is comparable to those of the Guajalito, Otonga, and Tandayapa on the western slope of the Andes (Jarrín and Fonseca 2001; Lee et al. 2006). These sites are of a similar elevation range to the Cosanga sites. In this study 15 species of bats were caught at the two Cosanga sites, while Guajalito had 16, Otonga 18, and Tandayapa 13 (Jarrín and Foseca 2001; Lee et al. 2006). The Shannon-Weaver index of bat diversity was $H' = 0.82$ for the Cosanga sites which is lower than those of Guajalito ($H' = 1.03$), Otonga ($H' = 1.02$), and Tandayapa ($H' = 0.88$). While we seem to have a similar absolute number of species, the Shannon index value has been lowered by the abundance of *S. oporaphilum* ($n = 86$) in the sample (Shannon and Weaver 1949).

The number of species shared between Guajalito, Otonga, and Tandayapa was 56 to 44 percent. The number of species shared with Cosanga and these sites range from 22 percent with Otonga to 37.5 percent with Guajalito. These much lower shared bat fauna data are not surprising given that the Cosanga sites are on the Cordillera Oriental and the other sites are in the western Andes. Members of the genus *Sturnira* were the most common bats at all four sites. However, the species of *Sturnira* that was most common varied with the site. *Sturnira ludovici* was the most common at Tandayapa and Guajalito, *S. bidens* was the most common at Otonga, and *S. oporaphilum* was abundant at the Cosanga sites. All of these locations have the bat families Phyllostomidae and Vespertilionidae, but only Cosanga and Otonga have molossids represented. In addition, Otonga had one individual emballonurid (Jarrín and Foseca 2001; Lee et al. 2006).

In conclusion, though we seem to have collected a good sample of the bat diversity, very few other orders are represented. We did not catch or see any sign of carnivores, for example, which is probably due to the rarity of carnivores (and other orders) and our sampling bias towards small mammals. We were, however, told by a resident at the Sierrazul site that a tapir had recently been spotted in the riverbed of the Río Aragón.

The long-term conservation status of this part of the Cosanga River is difficult to judge. There are nearby parks and ecotourist birding sites. There is also oil and gas development in the area. However, most of the human impact is in the form of roads, small towns, and small cattle ranches, which promote the cutting of forests.

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